2016 MgUE Proposal Guidelines

NASA Johnson Space Center

A primary function of operating in space is the deployment and retrieval of payloads. NASA uses a deployment system to eject payloads such as cube satellites from the International Space Station. In recent years, a deployment system encountered trouble failing to release satellites when commanded, and inadvertently or prematurely releasing satellites. Work to improve the mechanics and powering of the system has been a focus for NASA and its partners. Microgravity University for Educators (MgUE) invites teachers and students to be a part of the team to improve the solution.

Interested teams of educators will brainstorm with their students to design a Satellite Launching Experimental Device (SLED) that will automatically deploy a mock satellite into a targeted zone mimicking a Mars orbital insertion. Teams will prepare a proposal package to be reviewed by NASA. After a rubric scored review of all proposals, NASA will select teams to come to Johnson Space Center in Houston, TX (*expenses paid*) to conduct an investigation in a simulated microgravity environment.

Invited teams of educators will investigate whether a human interfaced manual deployment of the mock satellite or a SLED interfaced automatically controlled deployment of the mock satellite works best in the simulated microgravity environment produced by NASA's Precision Air Bearing Floor (PABF). Proposers are encouraged to become familiar with the technical specifications for using the PABF found in the appendices of the 2016 MgUE Proposal Guidelines.

Proposal Checklist:

Complete the following items below and submit the completed proposal package online at https://microgravityuniversity.jsc.nasa.gov/theProgram/micro-g-ue/index.cf by December 1, 2016 at 11:59 PM, CT:

- ⇒ Coversheet/Make-up of Team Members
- ⇒ Technical Section
  - * Abstract
  - * Test Objective
  - * Test Description
  - * Technical References
- ⇒ Safety Evaluation
- ⇒ Experiment Investigation Questions
- ⇒ Lesson Plan
- ⇒ Outreach Questions
- ⇒ Administrative Deliverables
  - * Test Week Preference
  - * U.S. Citizenship & Classroom Educator Form
  - * School/District Letter of Commitment

Please submit the proposal package in the order of the above items on this checklist. Acceptable file types are .rtf, .doc, or .pdf. PLEASE MINIMIZE YOUR FILE SIZE TO 20 MBs OR LESS! Transferring your file may take some time depending on connection speeds, server availability, etc. **Please be patient and wait for confirmation of your submission.**

Direct all questions to jsc-epd@mail.nasa.gov

Table of Contents of Your Proposal

(Descriptions found below in document.)

Scoring Rubric	
Technical Section	20%
Safety Evaluation	10%
Experiment/Investigation Questions for STEM Engagement	20%
Outreach Questions	20%
Lesson Plan	20%
Make-up of Team Members (Grade levels & Subjects Taught)	10%

I. Coversheet/ Make-Up of Team Members (10%)

"NAME OF EXPERIMENT"

"NAME OF TEAM"

"MISSION PATCH/LOGO" optional

DISTRICT/SCHOOL NAME:

DISTRICT/SCHOOL ADDRESS:

DISTRICT/SCHOOL PHONE NUMBER:

DISTRICT/SCHOOL POC-PUBLIC RELATIONS:

DISTRICT/SCHOOL POC-PUBLIC RELATIONS EMAIL:

<table>
<tr><td colspan="2">Team Lead Contact Information
Name:
School:
Grade(s) Taught:
Subject(s) Taught:
Email:
Phone:</td></tr>
<tr><td>Team Member 2 Contact Information
Name:
School:
Grade(s) Taught:
Subject(s) Taught:
Email:
Phone:</td><td>Team Member 3 Contact Information
Name:
School:
Grade(s) Taught:
Subject(s) Taught:
Email:
Phone:</td></tr>
<tr><td>Team Member 4 Contact Information
Name:
School:
Grade(s) Taught:
Subject(s) Taught:
Email:
Phone:</td><td>Team Member 5 Contact Information
Name:
School:
Grade(s) Taught:
Subject(s) Taught:
Email:
Phone:</td></tr>
</table>

II. Technical Section (20%)

The technical section should include information about the automatic Satellite Launching Experimental Design (SLED) the team is proposing. This section should include any information that a technical reviewer might find informative or instructive in understanding the aims and goals of the design. Evaluators will be ranking the proposal for its scientific merit. If your team is selected , a NASA mentor will be assigned to guide your team in the experimental design process.

A. Abstract

The abstract should be a brief (up to 300 words) summary that touches upon the elements of the automatic SLED design being proposed.

B. Test Objectives

This section should include a description of the design being proposed. Describe how the proposed launching device meets the design requirements of the Precision Air Bearing Floor (PABF) to be found in Appendix I. Describe a detailed plan on how your team created the SLED. *The plan may include details such as parts used within the NASA Satellite Launching Experimental Design (SLED) kit found in Appendix I and parts added to the design that are not included within the SLED kits. Only 10% of the design can be made up of parts that are not included in the SLED kit. Only selected teams will receive an SLED kit.* ***NO*** *fuels, compressed air, or solvents may be used in the design.* **Include at least one of the following for your design: a sketch or drawing, a photo, or a Computer Aided Design (CAD) model.** All picture files must be uploaded in a .jpg or .pdf format.

C. Test Description

This section should include a brief, but detailed description of the test being proposed. It should be written so that a practicing engineer or scientist can understand the design. Goals should be presented along with a description of the expected results (hypothesis). Be sure to include exactly how the test will be conducted and what the team expects to learn as a result of the experiment. Describe the quantitative and qualitative data to be collected and how it will be analyzed with your students.

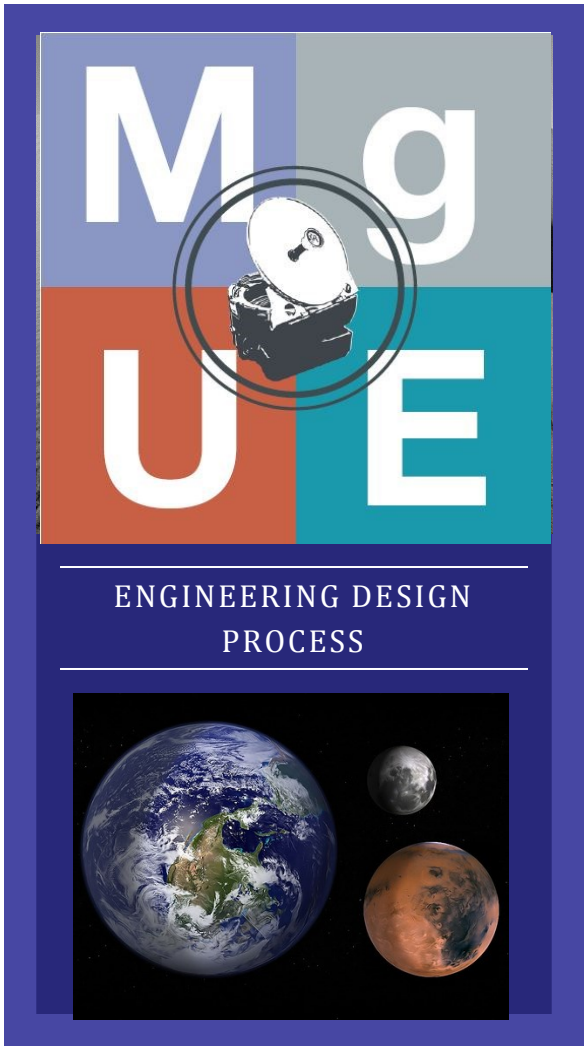
D. Technical References

Referenced works should be cited in text and in the "Bibliography." Standard APA format should be used.

***** Please refer to Appendix I for all technical specs of the PABF, SLED Kit, launch pad, and simulated orbital insertion target.***

III. Safety Evaluation (10%)

The safety evaluation section will be used by the review committee to confirm that each project is safe to handle on the ground and for usage on the PABF. When the launch team submits the proposal, it may not know exact dimensions or tensile strengths of parts and pieces planned for use; however, the team should be able to describe its plan to design, fabricate, and operate the experiment in a safe manner. **Safety is paramount; therefore, ranking in this category will place the team's experiment in a SAFE/GO, CONDITIONAL, or UNSAFE/NO GO category. Despite technical or outreach merit, designs considered UNSAFE/NO GO will not be considered for participation.** All teams selected will perform an Engineering Safety Review (ESR) in front of NASA's safety review board. The review board will advise on any actions that need to be changed on the SLED before launch day.



IV. Experiment/Investigation Questions (20%)

Information Sessions will be held on October 27, 2016 and November 1st & 17th, 2016 from 7-8 PM, CT to answer questions LIVE about the technical problem of the investigation. Please go to the information sessions tab located at Join the Blackboard Collaborate session to enter and learn more.

Please refer to the pre-selected NASA SLED kit and technical problem found in Appendix I before answering the experimental design questions. Please answer the following questions using the format below.

1. How did your students come up with your automatic SLED design?

Answer Here

2. What scientific concepts will be taught to your students when designing your SLED system for the Precision Air Bearing Floor (PABF)?

Answer Here

3. List the tasks or phases of the project and explain how students will be involved. (Examples to include: building the SLED, scientific research, planning the trip to Houston, post-deployment analysis, and publishing final report.)

Answer Here

4. Explain what your students think will happen during the manual satellite deployment on the PABF and why. (Hypothesis)

Answer Here

5. Explain what your students think will happen during the automatic SLED launch on the PABF and why. (Hypothesis)

Answer Here

6. How will these hypotheses be investigated and measured in the classroom prior to testing at NASA?

Answer Here

V. 5E Lesson Plan (20%)

Please create a lesson plan that will be used to teach students about microgravity and the engineering design process during the creation of SLED.

Grade/ Grade Band:	**Topic:**	**Lesson # _____ in a series of _____ lessons**
Brief Lesson Description:		
Performance Expectation(s):		
Specific Learning Outcomes:		
Narrative / Background Information		
Prior Student Knowledge:		
Science & Engineering Practices:	**Disciplinary Core Ideas:**	**Crosscutting Concepts: -**
Possible Preconceptions/Misconceptions:		
LESSON PLAN – 5-E Model		
ENGAGE: Opening Activity – Access Prior Learning / Stimulate Interest / Generate Questions:		
EXPLORE: Lesson Description – Materials Needed / Probing or Clarifying Questions:		
EXPLAIN: Concepts Explained and Vocabulary Defined: **Vocabulary:**		
ELABORATE: Applications and Extensions:		
EVALUATE: **Formative Monitoring (Questioning / Discussion):** **Summative Assessment (Quiz / Project / Report):**		
Elaborate Further / Reflect: Enrichment:		

VI. Outreach Section (20%)

It is required that the selected team members disseminate information about their experience to peer colleagues in the furthest reach of their education community. During the Face to Face Institute, all participants will connect virtually to their local schools and communities from NASA's test facility to describe their ongoing experience and share test results with their students.

Please answer the following questions using the format below.

1. During the opportunity, how will be peer educators (outside of the listed team members) within and beyond your local education community be involved with this investigation/experiment? What steps will you take to ensure their involvement? (Examples: parallel classroom investigations, social media, websites updates, or other)

Answer Here

2. Upon completion of this opportunity, how will you share this experience and information with other educators and the community? (Examples: in-service opportunities, production of a video, presentation at workshops, family science night, or other)

Answer Here

3. List all names of anticipated volunteers and partners that may help during the entire process. Include any educational, community, or business-related partnerships that may be used to support or enhance your investigation.

Answer Here

4. Please provide contact information for your school district's public information office. If there is a primary point of contact, please include their name, email, and phone number. Please provide any hashtags or tags that your school district or team members may have on social media.

Answer Here

#NASAMgUE

VII. Administrative Section

A. Test Week Preference

Please rank first and second preference for the test week to attend JSC. First choices are not guaranteed.

☐ Test Week One, April 2-7, 2017

☐ Test Week Two, April 9-14, 2017

B. U.S. Citizenship and Classroom Educator Form

By signing this document, you are indicating that you are a citizen of the United States and currently hold a position as a certified, K-12 classroom teacher. You are also agreeing to the following terms:

- I understand that, if selected, I will be part of the school or school district's experimental design launch team at JSC's Space Vehicle Mock-Up Facility on the PABF. I will fully participate in all scheduled events.
- I understand that, if selected, I am required to participate in an online tasks and series of pre- and post-onsite activities as part of this opportunity.
- I understand that, if selected, I am required to complete NASA requirement safety forms.

Please have each team member sign and date below. Signatures may be electronic (i.e. scanned into the document).

Team Lead

Team Member 2

Team Member 3

Team Member 4

Team Member 5

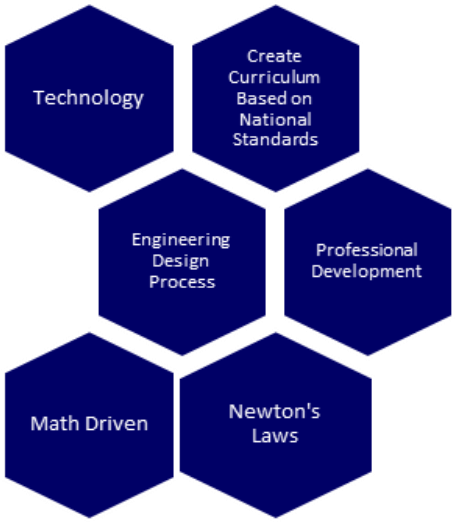
C. School/District Letter of Commitment

Support from your school and/or district administration is extremely important to the success of this project. A letter from your school or district administrator(s) stating support for the items below must be sent in as a part of the proposal *on school letterhead*. Proposals are considered incomplete without a Letter of Commitment. It is understood that the school and/or district will:

- Be responsible for funding substitute teachers for all team members while participants are in Houston during the experimental design testing week if the dates conflict with the school's in-session calendar. (Note: Launch team members will only test one of the two test weeks. The first test week is from April 2-7, 2017 and the second test week is April 9-14, 2017. Participants will be notified which test week they will be attending on December 15, 2016.)
- Be responsible for securing and funding shipping costs to send the satellite launch system device to and from Houston, TX.
- Provide additional planning time for those involved with this opportunity, if possible.
- Provide release time for team members to conduct professional development sessions for local/regional teachers and community programs as well as to participate in online professional development.
- Coordinate media relations/outreach with NASA's Office of Communications and the local school system's Public Information Office.

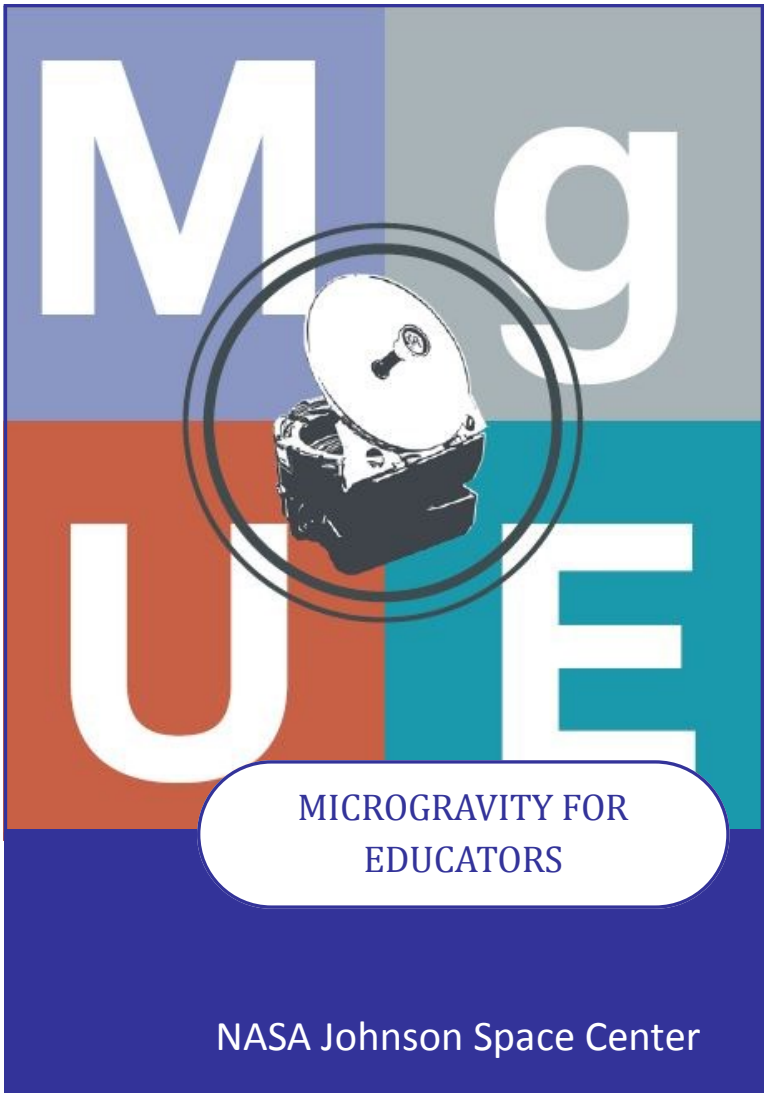
Please ensure that the single Letter of Commitment covers all team members and all items listed above. If necessary, please attach additional Letters of Commitment from team member's schools to ensure all items and team members are covered. **Please use school letterhead.**

NASA Internships Specialist, Melissa Corning, experiments on the PABF. Photo Credit: NASA



APPENDIX

Technical Specs of Precision Air Bearing Floor (PABF)



Technical Problem:

Design an automatic Satellite Launching Experimental Design (SLED) that will mimic orbital insertion around Mars on a 2-D simulated microgravity environment at NASA Johnson Space Center (JSC) on the Precision Air Bearing Floor (PABF).

Precision Air Bearing Floor (PABF):

The PABF or "flat floor" is a 70' X 98' epoxy surface designed to support rendezvous and contact testing that require low friction movement of test articles along a flat surface.

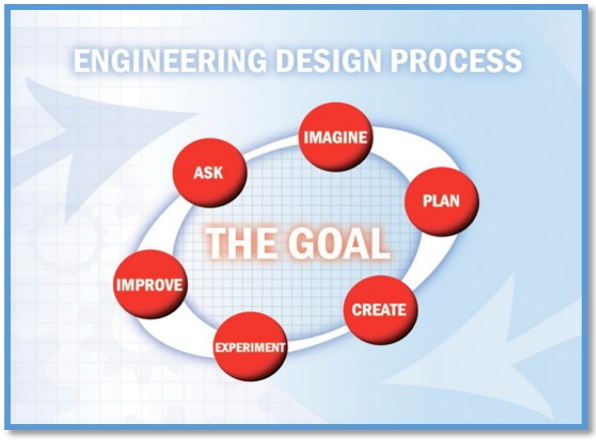
Test articles are mounted on perforated pads that distribute a cushion of compressed air between the pads and the floor. The test articles "ride" on the air cushion and do not contact the floor. The floor is level within .003 inches per foot and .005 inches per 10 feet. It is polished to within 250 micro inches average deviation. It is positioned between a large manipulator facility and a gravity offload facility for accessibility.

How the System Works

The air bearings use compressed air to suspend and enable frictionless movement of mockups and hardware. Commercial rubber skirted air bearings are used with large loads. Ground plates with orifices are used for smaller loads. Typically, air is supplied via a hose to a compressed air source; bottled gas is an option. A 2,000 lb hoist and jib are mounted on the north edge of the ABF to support positioning of small modules onto the floor. Co-located with this hoist are 120 psi utility air and hose reel, 4,000 psi air outlet, and a utility electrical power.

Satellite Launching Experimental Design (SLED) Kit Contents:

All selected teams will receive an SLED kit that contains the following items:



- 1 Eight Inch Diameter Satellite Hovercraft
- SLED Launchpad Attachment (mounts to launch pad)
- Nuts and Bolts (different sizes)
- Duct Tape
- Rubber Bands (different sizes and strengths)
- String
- Tongue Depressors/Craft Sticks
- Springs (different sizes and strengths)
- Bungie Cords (different sizes and strengths)
- 1 & 2 inch strips of Aluminum Tubing 1-2 feet long
- 5 feet of Rubber Tubing
- Paper Clips
- Straws
- Masking Tape
- Clothes Hanger
- Paper Towel Rolls
- Balloons
- 9 Volt Battery
- Magnets (different sizes and strengths)

****90% of your design materials must come from the SLED kit. ONLY 10% of materials not found in the SLED kit can be used in the design due to safety constraints.**

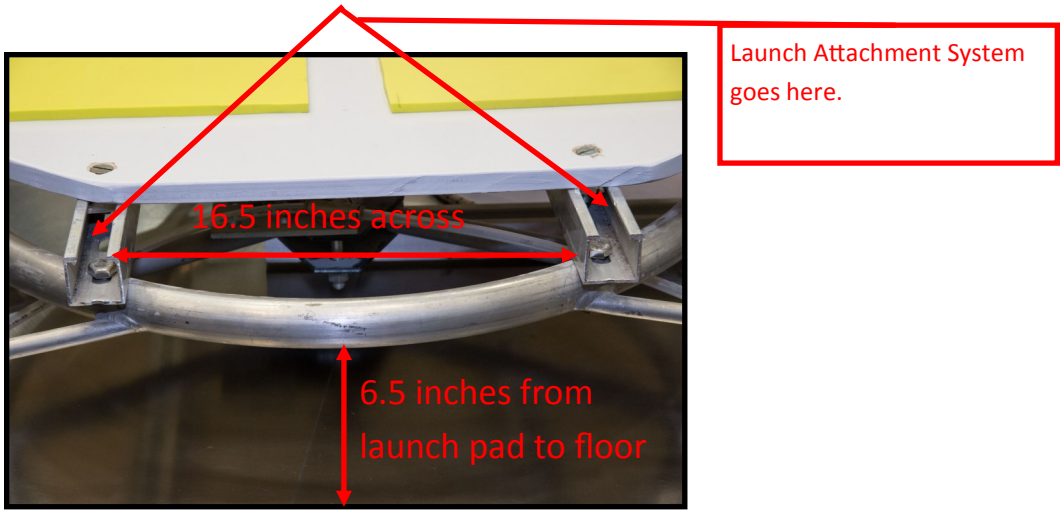
**** NO fuels, compressed air, or solvents may be used in the design.**

Manual Launch System Pad:

One participant per launch team will be required to sit on the launch pad and manually deploy the satellite to obtain data for comparison against the teams SLED device. Below is a picture of the PABF launch pad that will be moving backwards away from the simulated orbital insertion target. This will represent an extra-vehicular activity (EVA) or spacewalk mission off of the International Space Station's (ISS) Remote Manipulator System (SSMRS), known as the robotic arm.

Automatic SLED Launch Pad:

Each selected team will be given a launch pad attachment system to mount their device. Your design your team must have an adjustable interface for height. Your team must have the launching device 1/4 of an inch off of the PABF. **No exceptions.** Your automatic SLED **must** keep the satellites velocity below 5 feet/second. Please refer to the launch pad below and the attachment system.



Simulated Orbital Insertion Target:

All teams will be using mathematical calculations to help reach the target of simulated orbital insertion around Mars. Below is a picture of the target with measurements of the insertion points.

Target will be moving 1ft/sec